Where the Wild Things Are:

Large Mammal Habitat and Corridors in Burlington, Vermont

Submitted by Alicia Daniel and Mark Ward
Winooski Valley Park District, October, 2000

The Winooski Valley Park District is a partnership between Burlington, Colchester, Essex, Jericho, So. Burlington, Williston, and Winooski created to preserve urban natural areas for the purposes of wildlife conservation, education and passive recreation.

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Bonnie Acker created the art and Ron Baker designed the graphics for the cover.

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Finally, Susan Morse and Lars Botzojorns of Keeping Track made all of the tracking data we gathered possible through their tireless dedication to Vermont wildlife.

Table of Contents

Glossary[1]

Area-sensitive species: A resident wildlife species that requires a relatively large area to sustain a genetically viable population.

Baseline monitoring: Long term assessment of a wildlife population or a habitat without planned evaluation of a specific impact. The goal of a baseline monitoring program is to detect population changes that cannot be predicted at the time the program is established.

Core habitat: In conservation biology literature, the term "core habitat" generally applies to an expanse of habitat that provides all the necessary elements of food, shelter, water, and adequate space to support a viable population of a species. But, for the purposes of this study, it is defined as an expanse of habitat that provides all the elements necessary to support a resident large mammal on at least a seasonal basis.

Corridor: An area that does not necessarily provide all elements of habitat for a species but connects two or more areas of core habitat in a way that movement of the species between the areas can occur.

Extirpation: The elimination of a population of animals from an area.

Habitat: The entire complex of terrain, cover, water and food that constitutes the area supporting a population of a particular wildlife species.

Large mammal(s): For the purposes of this study, the term refers only to the following species: bear, beaver, bobcat, coyote, deer, fisher, fox, moose, mink, and otter.

Resident: An individual animal living within an established home range.

Scat: Fecal material of any animal.

Sign: Any evidence of presence left by an animal. This includes tracks, scat, scrapes, claw marks in trees, antler rub marks on trees, urine in snow, etc.

Sighting: Refers to a clear view of an animal that allows for the positive identification of the species.

Tracks: Refers only to the footprints left by a walking or running animal of any species.

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[1] Many of these definitions are adapted from Shaw, Harley and Hass, Christine (1999) Keeping Track® Project and Data Management Protocol

Executive Summary

The City of Burlington sits on a rich site where land meets water. Mink and otter seek out prey such as fish, amphibians, and young ducks in the area's abundant wetlands. Foxes dig dens in the sandy delta soils. Bear and moose come down from the mountains to the Champlain Valley to eat early spring shoots and buds. The landscape in and around Burlington forms a natural link between the Green Mountains and Lake Champlain.

Within the past decade, in surveys on the merits of open space, the citizens of Burlington have repeatedly voiced their desire to protect wildlife habitat and corridors as one of the primary values associated with open space. In addition to serving essential ecological functions, wildlife habitat enriches human experience by providing opportunities for recreation and education. Presently, many of Burlington's natural areas are linked to other natural areas within the City and habitat in surrounding towns. Nationwide, many urban natural areas exist as virtual islands within a sea of development and, as such, are incapable of sustaining large wild mammals. Presently, many of Burlington's natural areas are linked within the City and to habitat in surrounding towns. It is crucial that large natural areas remain openly connected to other suitable habitat in order to sustain resident wild animals. Planned connections also ensure adequate genetic diversity over the long term and provide the possibility of new replacements in the event of local declines. Inventorying and identifying where wildlife lives in Burlington now is the first step in ensuring the continued presence of wildlife within the City.

The Winooski Valley Park District (The Park District), its seven member towns, and six conservation commissions have facilitated the training of nearly 50 citizen scientists from its seven member towns through the Keeping Track® training program since 1997. The purpose of this initiative is to document wildlife presence in the region and to help guide Park District management decisions within its own system of publicly-owned natural areas. The Park District recently received three grants from private foundations to provide technical assistance to towns in their conservation planning efforts through the Large Mammal Habitat and Corridors Project.

Through a series of meetings with Burlington residents and town planners, project directors established baseline data for large mammal sightings in the City of Burlington and created a preliminary large mammal habitat map for the city. Keeping Track® trained trackers collected data on mammal presence by strategically tracking at certain natural areas and suspected corridors throughout the winter months of 1999-2000. The locations of track, sign and sightings were plotted on an ArcView® GIS layer and used to create a refined large mammal habitat map.

The mammal habitat map clearly identifies large parcels of contiguous habitat and helps identify the corridors that connect them. The areas that stood out as core mammal habitat in Burlington were the Winooski River Corridor, Centennial Woods, and the area west of North Avenue (including Rock Point, Arms Grant, and North Beach). The largest open space parcels yielded the highest diversity of species sightings, but the data cannot be looked at independently of tracking efforts. Within the past 5 years, each of the ten focal mammal species has been reported from the Ethan Allen Homestead and Burlington Intervale and seven species have been recorded from Centennial Woods. Strategic winter tracking helped identify three suspected movement corridors within Burlington: across

North Avenue, across Grove Street and along the lakeshore. In order to sustain and replenish populations of large mammals in Burlington, connections to open space and high quality habitat in neighboring communities must also be preserved.

A total of 106 records of tracks, sign, or sightings were compiled from all sources. The most commonly encountered species were red fox (30 records from 18 sites) and mink (21 records from 13 sites). Deer, moose, fisher and beaver were the next most commonly encountered species. The combination of Keeping Track® transect data and strategic winter tracking reports accounted for more than half (53%) of all mammal records in Burlington. This project demonstrates the efficacy of focused tracking efforts for documenting mammal presence, even with small numbers of trained trackers in a single winter season.

Ongoing efforts to document the presence of large mammals and their use of habitat and corridors in Burlington will be collaborative and involve Winooski Valley Park District, Keeping Track®, UVM, town planners, and the Burlington Conservation Board.

From this project the following recommendations for City action emerged:

1. Ensure long term protection of core habitat. The best examples of core mammal habitat in Burlington are:
   a) the Winooski River Corridor (comprising the Burlington Intervale, Ethan Allen Homestead, Howe Farm, and Derway Island)
   b) Centennial Woods
   c) the lake shore and upland natural areas west of North Ave and north of the Urban Reserve (encompassing North Beach, Rock Point and the Arms Grant).
2. Make protection of habitat connectivity, including key corridors, a priority.
3. Work with people in neighborhoods of suspected wildlife corridors to maintain their land's permeability to wildlife.
4. Restore existing publicly owned features to improve wildlife movement.
5. Continue monitoring to confirm animal movement and to help assess the status of animal populations, both through Keeping Track® transect monitoring and strategic winter tracking.
6. Consider adding a Large Mammal Habitat and Corridor Map to a future Open Space Planning document.
7. Review and enforce violations of environmental regulations that adversely affect wildlife and their habitat within the City.
8. Consider posting animal crossing signs at the corridors across North Avenue.

Introduction

The City of Burlington sits on a rich site where land meets water. Mink and otter seek out prey such as fish, amphibians, and young ducks in the area's abundant wetlands. Foxes dig dens in the sandy delta soils. Bear and moose come down from the mountains to the Champlain Valley to eat early spring shoots and buds. The landscape in and around Burlington is a natural link between the Green Mountains and Lake Champlain.

Within the past decade, in surveys on the merits of open space, the citizens of Burlington have repeatedly voiced their desire to protect wildlife habitat and corridors as one of the primary values associated with open space.[1] In addition to serving essential ecological functions, wildlife habitat enriches human experience by providing opportunities for recreation and education. Nationwide, many urban natural areas exist as virtual islands within a sea of development and, as such, are incapable of sustaining large wild mammals. Presently, many of Burlington's natural areas are linked within the City and to habitat in surrounding towns. It is crucial that large natural areas remain openly connected to other suitable habitat in order to sustain resident wild animals. Planned connections also ensure adequate genetic diversity over the long term and provide the possibility of new replacements in the event of local declines. Inventorying and identifying where wildlife lives in Burlington now is the first step in ensuring the continued presence of wildlife within the City.

Large Mammals: Historical Context for Conservation

At the close of the 19th century, it would have been impossible to see deer, beaver, coyote, moose or fisher within the City limits even though Burlington was much more rural than it is today. By the late 1800s, the twin forces of deforestation and unregulated hunting and trapping had resulted in the extirpation of these and other species in Vermont. Some--like the mountain lion, wolf, and elk--have yet to return.

But the diversity of large mammals in the area is on the rebound. Vermont biologists reintroduced deer (1878), beaver (1921), and fisher (1959) and the populations

[1] City of Burlington Open Space Protection Plan 2000, draft #4, p. 8

of these species have increased dramatically with the regeneration of forested habitat in Vermont[2] and stronger hunting and trapping regulations. Other species such as moose and coyotes have expanded their ranges in response to habitat changes and reduced predation and competition from wolves. A visitor to the wilder places in the City after a winter snow can now *expect* to see the tracks of large mammals. That is, in a sense, miraculous.

Burlington's Commitment to Habitat Protection

The City of Burlington, especially within the last decade, has recognized the need to identify and protect wildlife habitat and movement corridors. The 1996 City of Burlington Municipal Development Plan listed several criteria used to identify "Natural Areas of Local Significance," including: "land containing critical habitat for migratory waterfowl, fish and other wildlife" and "migration corridors that link natural communities."[3] In 1997, the Burlington City Council passed a resolution calling for the creation of a plan to protect important natural areas and open spaces. Among the goals of this resolution was the need to "maintain, improve, and enhance the city's urban forest, including wooded corridors/treebelts that provide places of refuge and travel corridors for wildlife and people."[4] This resolution resulted in the development of the Open Space Protection Plan 2000, which has been released for public review and comment at the writing of this report.

In a public opinion survey of Burlington residents conducted for inclusion in the Open Space Protection Plan 2000, a majority of respondents identified the preservation of "natural areas and threatened habitat" as the most important goal of open space protection.[5] Among the specific needs cited during the same survey was a study to look at wildlife travel corridors. Given the importance of wildlife to Burlington residents, how can the City best ensure the continued presence of large mammals?

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[2] Forested area in Vermont has increased from a low of 30% in the late 1800s to almost 70% today.
[3] City of Burlington Municipal Development Plan (1996) p II-4.
[4] City of Burlington Open Space Protection Plan 2000, Draft #4, p. 2.
[5] City of Burlington Open Space Protection Plan 2000, Draft #4, p. 8.

Large Mammal Habitat and Corridors Project

The Winooski Valley Park District (the Park District), its seven member towns, and six local conservation commissions have facilitated the training of nearly 50 citizen scientists through the Keeping Track® training program[6] since 1997. The purpose of this initiative is to document wildlife presence in the region and to help guide Park District management decisions within its own system of publicly-owned natural areas. Keeping Track's mission is to inspire community participation in the long-term stewardship of wildlife habitat. They teach concerned adults and children to observe, interpret and record evidence of wildlife in their communities, enabling communities to become involved in the appropriate long-term stewardship of wildlife habitat. Keeping Track's focus on wide-ranging mammals provides a vital indicator of the ecological health of the landscape as a whole. Their training focuses on five area sensitive carnivore species (bobcat, bear, otter, mink and fisher) and moose. Trained trackers are currently monitoring eleven, two-and-a-half mile transects in Chittenden County, including one in Burlington. The information that they are gathering provides those interested in wildlife conservation with a better idea of where large mammals are currently found in the region.

In the fall of 1999, the Park District received grant funding from the Lintilhac, Meetinghouse, and Switzer Foundations to support the Large Mammal Habitat and Corridors Project. The goals of the Large Mammal Habitat and Corridor Project are:

- to coordinate Keeping Track® volunteer efforts by looking at the placement of monitoring transects within a regional context and
- to provide technical assistance to cities and towns who want to use tracking data and habitat expertise in their conservation planning efforts.

The Park District hired professional naturalists Mark Ward and Alicia Daniel to direct the project and had them enroll as Keeping Track® trackers. Mark and Alicia are both graduates of the UVM Field Naturalist Master of Science program and have over 20 years combined experience working in conservation.

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[6] For more information contact Keeping Track® PO Box 848, Richmond, VT 05477.

Large Mammal Habitat and Corridors in Burlington

The objectives of the Burlington initiative address both the needs of the City of Burlington as expressed in the Open Space Protection Plan 2000 and the goals of the Large Mammal Habitat and Corridors Project. This initiative serves the dual purpose of creating a large mammal habitat and corridor map for the City of Burlington, while also creating and documenting a *process* for mapping large mammal habitat for other towns. The objectives are to:

- design an approach to identifying and mapping large mammal habitat and corridors at the municipal-level while looking for connectivity within a regional context to facilitate a proactive process for protecting significant large mammal habitat and corridors.

- gather data about large mammal presence within Burlington with the assistance of Keeping Track® trained, local trackers and other experts.

- create a large mammal habitat and corridors GIS database and map for use in town planning.

- provide information to the Conservation Board and City commissions involved in the project review process regarding valuable wildlife areas identified in the study.

- make recommendations for City actions that can increase protection for large mammals and their habitat.

Methodology

Action I: Met with town officials.

Convened a meeting with representatives of Burlington's Planning and Zoning and Conservation Board.

Goals:

- To establish whether there was interest in the project.
- To look at where the Large Mammal Habitat and Corridors Project fits into the current planning process.
- To determine mammals to focus on in an urban area.

Outcomes:

It was clear that the project could address needs expressed in the current Open Space Plan and in the 1996 Municipal Plan. Project directors:

1) decided to convene an Advisory Group
2) and developed a list of mammal species to focus on in Burlington, which included the Keeping Track® focal species, plus four other species (deer, fox, coyote, and beaver).

Action II: Met with Experienced Local Residents.

Convened a meeting with an Advisory Group made up of Burlington residents who are familiar with Burlington's Natural Areas and have an expertise in wildlife ecology, botany, town planning, and/or GIS mapping.

Goals:

- To re-examine the purpose and scope of the project as it relates to City planning.
- To draft a preliminary map of large mammal habitat in Burlington.
- To look for possible corridors between the prime large mammal habitats already identified in part by the Conservation Board.
- To record sightings of focal species and their track and sign over the past 5 years.
- To discuss a strategic winter tracking plan.

Outcomes:

Using a mylar overlay on the Burlington 1999 Open Space Map, the Advisory Group identified locations of personal eyewitness mammal sightings. The group then used this information and their knowledge of Burlington's open spaces, to draft a rough map of large mammal habitat that included large natural areas and connections between them. It was agreed that strategic winter tracking efforts should focus on possible corridors connecting large natural areas, because 1) the presence of mammals in linkage areas implies presence within the connected natural areas and 2) corridors, since they have not been identified as natural areas, *may* be more threatened.

Action III: Established a Strategic Winter Tracking Plan.

Goals:

- To define a strategic winter tracking protocol that participants would utilize to standardize data collection.
- To divide the area into parcels small enough to be covered by an individual tracker in about an hour (so that tracking could be done before work.)
- To identify qualified local participants (people who had either completed the Keeping Track® training or had equivalent experience).

Outcomes:

1. The strategic winter tracking protocol encouraged participants to visit assigned areas a day or two after a fresh snowfall to document tracks and sign of target species that they encountered (Appendix I).
2. Several areas were chosen for inclusion in strategic winter tracking for the winter of 2000 (Figure 1).
3. The following individuals were recruited to participate in strategic winter tracking at assigned areas:

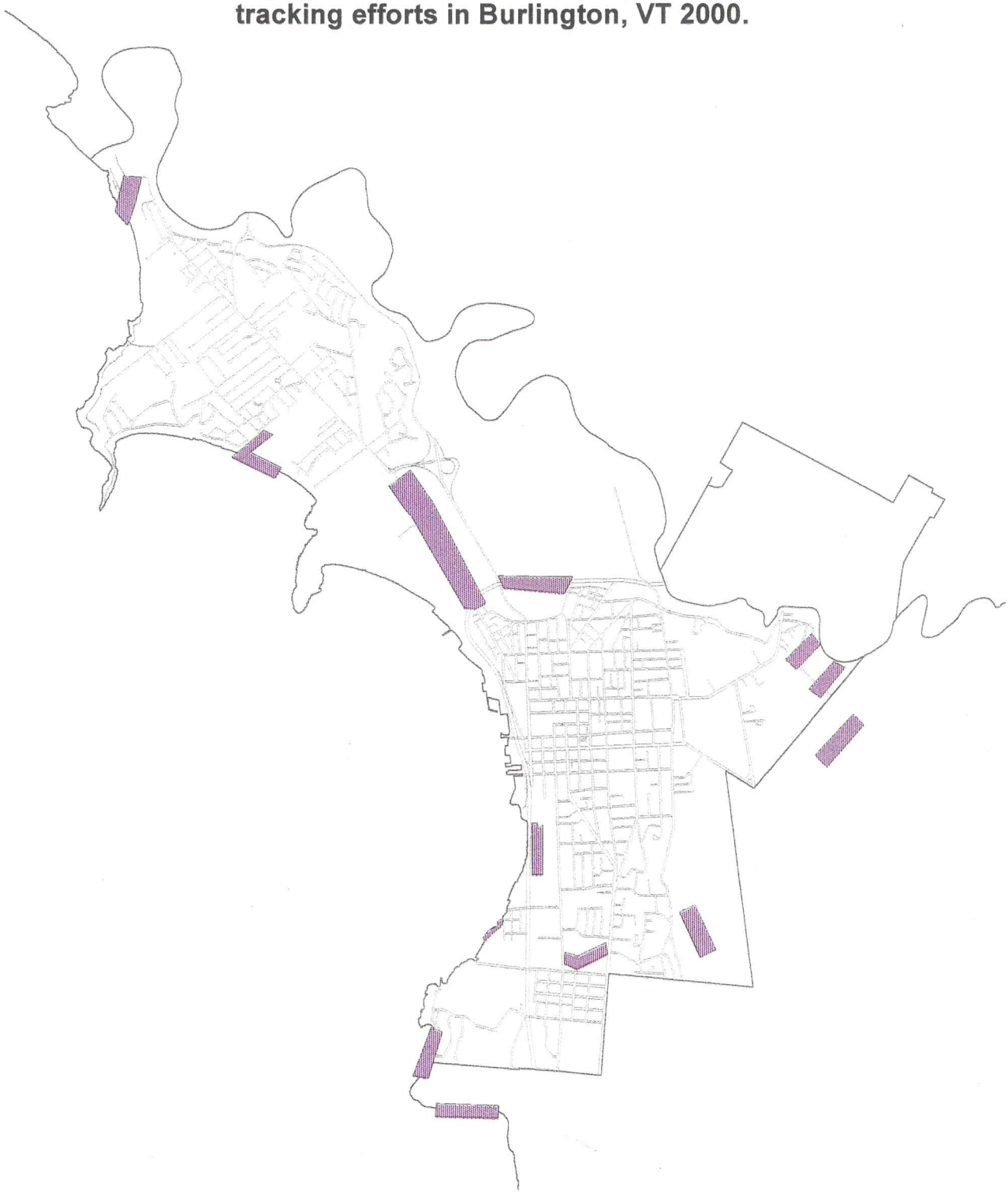
Ron Baker & Jennifer Ely – North Avenue from Manhattan Drive to Killarney Drive,
Alicia Daniel – Englesby Ravine and Burlington Country Club,
Ben Gabos – Grove Street/Centennial Brook & Valley Ridge area,
Jeffrey Severson – Shoreline areas in Burlington south,
Mark Ward – Centennial Woods culverts, Leddy Park, Derway Island/Northshore Wetland.

Action IV: Mapped Mammal Track, Sign, & Sighting Locations and Mammal Habitat & Corridors.

Goals:

- To spatially document locations of recent mammal track, sign, & sightings.
- To establish a database of mammal track, sign, and sighting locations that can be updated.
- To create a mammal habitat and corridor map for the town of Burlington.

Figure 1. Locations of strategic winter tracking efforts in Burlington, VT 2000.



Outcomes:

1. The locations of tracks, sign, and sightings for all large mammals were compiled in an ArcView® GIS data layer and then plotted (Figure 2). The information used to compile these points came from several sources: strategic winter tracking, eyewitness reports from the Advisory Group and from other reliable sources, Keeping Track® transect data (gathered quarterly from the Ethan Allen Homestead and the Burlington Intervale since 1999), UVM Field Naturalist Program reports (available for Arms Grant, Intervale, Northshore Wetland, and Centennial Woods), and newspaper clippings. Information for each data point was entered into an attribute table to allow easy addition of future data points and to provide a variety of means to replot and/or reanalyze data (Appendix II).

2. A large mammal habitat ArcView® GIS data layer was created using the parcels on the 1999 Open Space Map. Each parcel on the Open Space Map was screened for selection based on its location, open space designation, and proximity to known mammal locations. The parcels that met these criteria were then mapped as large mammal habitat (Figure 2). In this way, the directors excluded developed land, even though in some cases large mammals may use it.

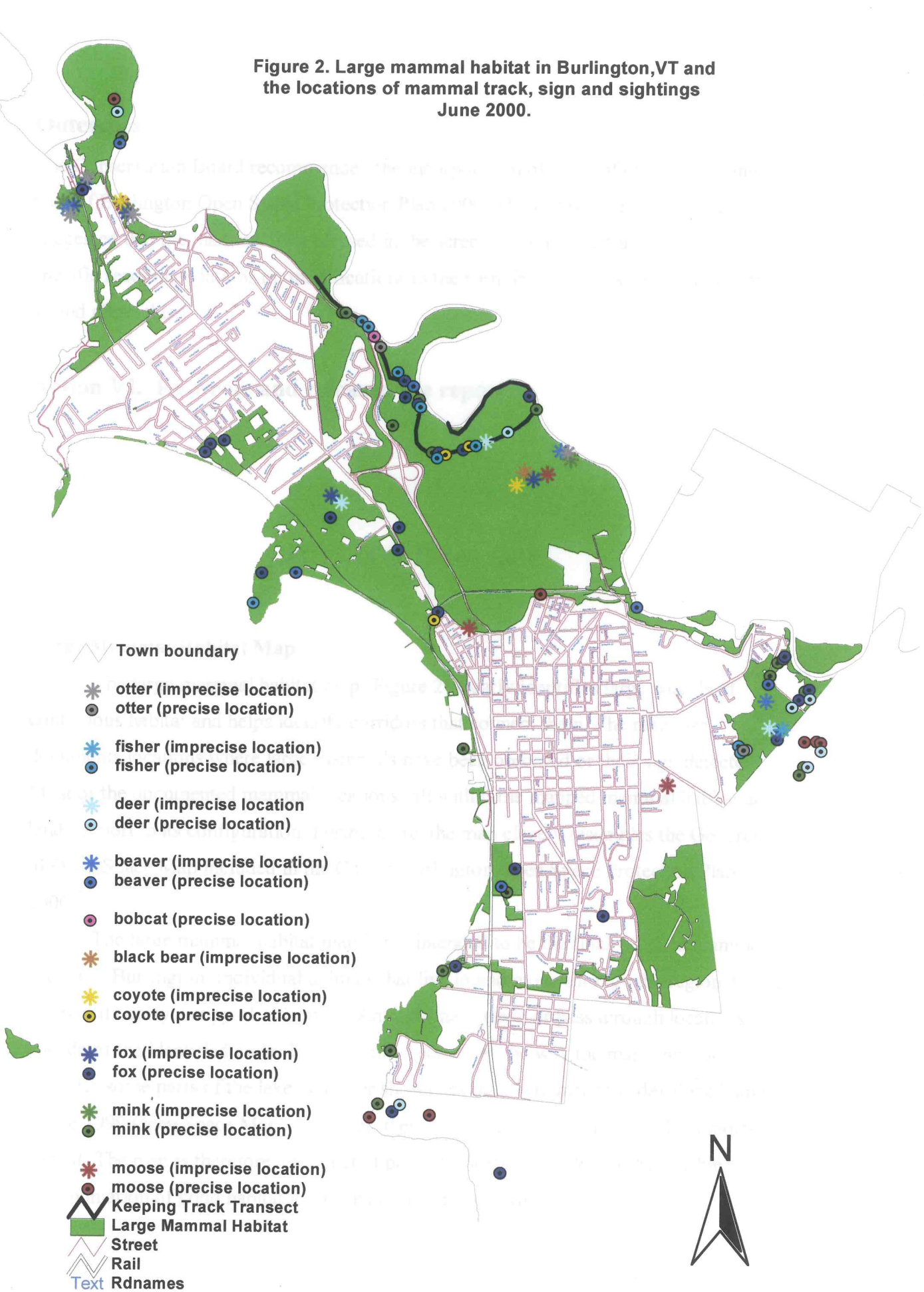
Action V: Wrote, Revised and Edited the Draft Document.

Wrote a draft of the report. Convened further meetings with Planning and Zoning, the Conservation Board and Advisory Group members.

Goals:

- To get feedback on the document outline.
- To refine data tables and map.

Figure 2. Large mammal habitat in Burlington,VT and the locations of mammal track, sign and sightings June 2000.



Outcomes:

The Conservation Board recommended the incorporation of some of our findings into the City of Burlington Open Space Protection Plan 2000. The Conservation Board also suggested that the mammal data be used in the screening of projects and asked for specific recommendations on modifications to their Environmental Assessment Form that would allow this.

Action VI. Re-wrote and released the report.

Results & Discussion

Large Mammal Habitat Map

The large mammal habitat map (Figure 2) clearly identifies large parcels of contiguous habitat and helps identify corridors that connect them. The map also documents locations where large mammals have been observed or their sign detected. Most of the documented mammal locations fall within the mapped mammal habitat and lend support to its configuration. Furthermore, the map closely resembles the Geography of Open Space Map included in the City of Burlington Open Space Protection Plan 2000.[7]

The large mammal habitat map is not intended to be the final word on mammal habitat in Burlington. Individual animals that live in and move through the region do not necessarily carry a copy of this map! Animals may reside or pass through locations outside of the identified areas. For example, because of the way the map was made it excludes some parts of the lake and river shorelines that were mapped "developed land" on the 1999 Open Space Map. However, these segments of shoreline may be important habitat. The map is therefore a product of present efforts and reflects a reasonable approximation of good habitat in the city at the present time.

Core Habitat

Several areas from the map stand out as large contiguous parcels and represent the heart of the best mammal habitat in Burlington. These areas include: the Winooski River Corridor (including the Intervale, Ethan Allen Homestead, Howe Farm, and Derway Island), Centennial Woods, and the area west of North Avenue (including Rock Point, Arms Grant Woods, and North Beach).

In general, the largest open space parcels yielded the highest diversity of species sightings. For example, each of the ten focal mammal species has been reported from the Ethan Allen Homestead and the Burlington Intervale within the past 5 years—7 within the past winter. Further down the Winooski River Corridor, seven species have been reported from Derway Island—6 within the past winter. Similarly seven species have been recorded in Centennial Woods—4 within the past winter.

However, the species diversity data cannot be looked at independently of tracking effort, which was not distributed uniformly over all areas. For example, four species have been recorded from the area that includes Arms Grant Woods and Rock Point, but none were reported this past winter, in large part, because no tracking was done there. Tracking at this location would no doubt produce both a greater abundance of documented sightings and a more extensive list of species. Similarly, no species were reported from the Howe Farm in the Winooski River Corridor, because again no tracking was done there.

Suspected Corridors for Large Mammals

The mammal habitat data layer suggests that several important corridors may connect core areas (Figure 3). They include:

- suspected corridors across North Avenue that link wetlands to the east with terrestrial habitat to the west,
- suspected corridors across Grove Street that link Centennial Woods to the Winooski River, and
- sections of the lakeshore that connect pockets of good terrestrial shoreline habitat.

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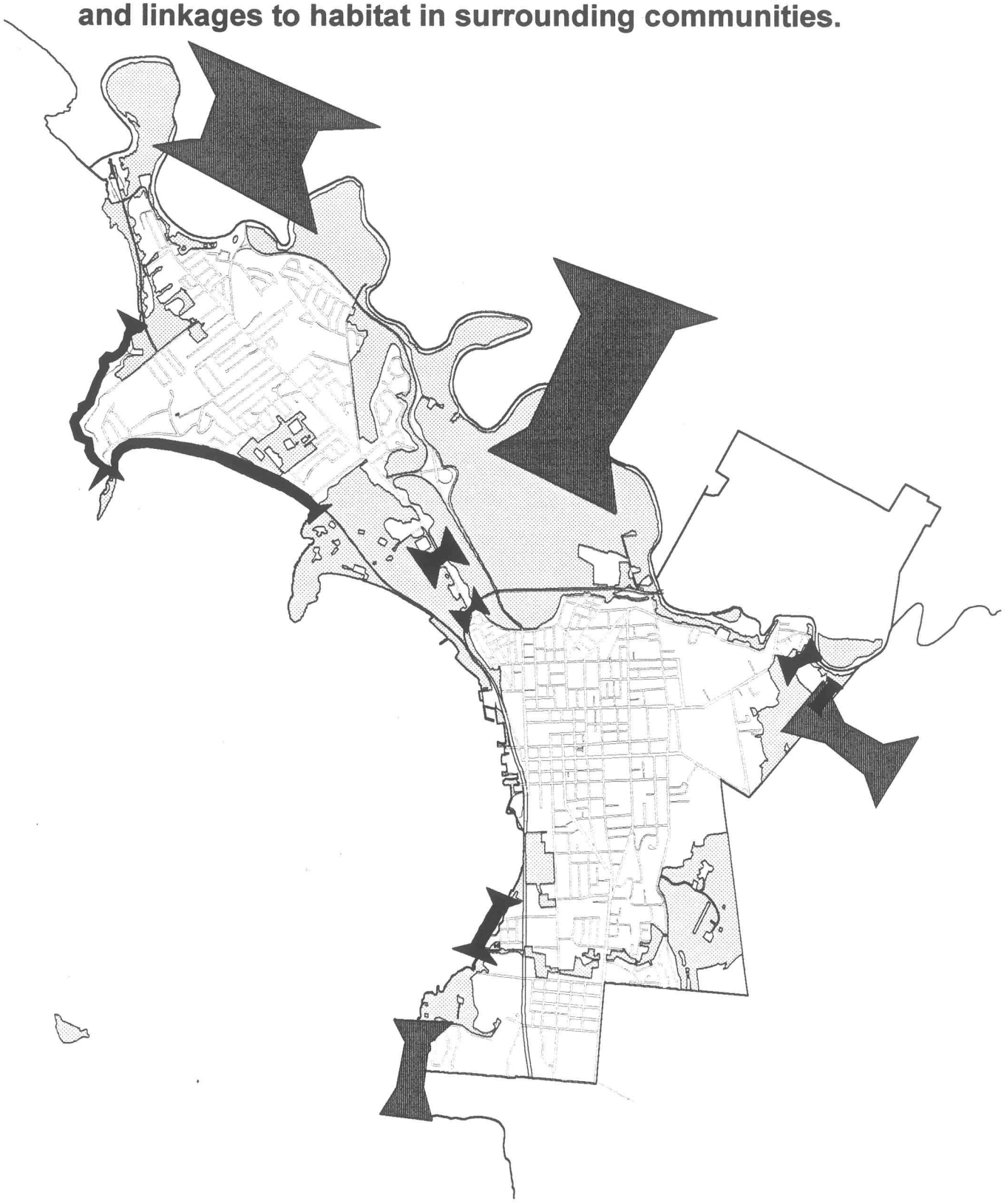
[7] City of Burlington Open Space Plan 2000, Draft #4 p. 45.

Figure 3. Identified mammal corridors in Burlington and linkages to habitat in surrounding communities.



Strategic winter tracking efforts at each of these locations documented their use by large mammals this past winter. These data support the notion that these connections function as movement corridors.

The section of North Avenue that passes over the railroad tracks was used by two species (fox and coyote). It represents a narrow, but apparently functional connection between the wetlands of the Intervale and the Urban Reserve/Waterfront. A set of fox tracks were observed coming from the steep, east-facing escarpment at the western edge of the Intervale and crossing North Avenue above the railroad tracks moving. Numerous fox digs were observed in the sandy soils of the east-facing escarpment. Evidently fox also cross North Avenue near the northern boundary of Lakeview Cemetary. Fox tracks were observed on both sides of the road at this location. These tracks lend further evidence to support the notion that mammals move across North Ave.

A second suspected corridor connects the Winooski River and its wetlands to Centennial Woods. A set of mink tracks was observed in Centennial Brook on both sides of Grove Street. The animal apparently passed through the culvert under Grove Street moving upstream into Centennial Woods. Further east on Grove Street, a set of fox tracks was observed that crossed Grove Street moving from Valley Ridge (just west of an abandoned building) into Centennial Woods. The same area is presumably used by deer (whose tracks were observed on both sides of the road) and possibly by moose (fresh moose tracks were observed in Centennial Woods this winter on three consecutive weekend visits).

The shoreline of Lake Champlain presumably functions as an aquatic corridor that links scattered parcels of good terrestrial habitat. When information from all shoreline locations was viewed collectively, the lakeshore has been visited by five target species. This aquatic corridor seems to be especially important for mink, which were reported from several locations this winter including Red Rocks, South Cove Beach, Blanchard Beach, and the Barge Canal.

Finally, connections to open space and high quality mammal habitat beyond the City's limits are critical to sustain and replenish populations of large mammals in Burlington. Some of the best examples of contiguous open space in the neighboring communities of South Burlington and Colchester include: sections of Centennial Woods and the woods and wetlands to the east of I-89, Macrae Farm and the Colchester Intervale, and Red Rocks Park (Figure 3).

Large Mammals in Burlington

A total of 106 records of mammal tracks, sign, or sightings were compiled from all sources (Appendix II). The most commonly reported species was red fox. It was reported a total of 30 times from 18 different locations in the city (see Table 1). This should come as no surprise since red fox is one of the few species that has benefited from human manipulation of the landscape. Its preference for a mix of rolling farmland, wooded areas, and wetlands made it well suited to the changes brought by European settlement. Alteration of the physical landscape in combination with the extirpation of large carnivores throughout much of the continental US has led to a dramatic range expansion for this species throughout North America.

Mink, the second most commonly reported species, was reported 21 times from 13 different locations. Mink, chiefly found in aquatic habitats, were identified predominantly along the lakeshore, the Ethan Allen Homestead and other parts of the Winooski River Corridor. Beaver and deer were each reported from six locations and moose and otter from five each. Deer and moose use both upland and wetland habitats and were noted both in the Winooski River Corridor as well as in upland areas like Centennial Woods. Almost all river otter were reported from the Winooski River Corridor, but otter use other areas as well as evidenced by a report from Centennial Woods. Fisher, a forest species once thought to be restricted to large tracts, was reported ten times (8 times in the last two years) from three locations. A rarely seen species, the fisher is a good example of how trained trackers can rapidly increase the number of reports for some species. Six fisher reports were generated by quarterly monitoring of a Keeping Track® transect at the Ethan Allen Homestead and Burlington Intervale.

Table 1. Burlington Large Mammal Tracks, Sign, and Sightings (June 2000)

A summary of large mammal occurrences in the City of Burlington, Vermont compiled from direct observations of animals, tracks or sign.

Location	Red Fox (Grey shown)	Mink	Beaver	Deer	Moose	Otter	Fisher	Coyote	Bear	Bobcat	Number of species
Ethan Allen Homestead/ Burlington Intervale	•	•	•	•	•	•	•	•	•	•	10
Winooski R.: Derway Island	•	•	•	•	•	•		•			7
Centennial Woods	•	•	•	•	•	•	•				7
Northshore Wetland	•	•	•			•					4
Red Rocks area	•	•		•	•						4
Rock Point	•		•				•				3
Bikepath North/ Derway- N. shore	•	•				•					3
Barge Canal	•	•	•								3
Valley Ridge	•	•		•							3
Arms Grant	•			•							2
North Avenue/ RR crossing	•							•			2
Centennial Brook	•	•									2
Blanchard Beach/Oakledge		•									2
Lakeview Cemetery	•										1
Sea Caves Upland	•										1
Leddy Park	•										1
Landfill Road / RRTracks					•						1
Lake Shore: Boat House		•									1
Englesby Ravine	•										1
Country Club	• (grey)										1
South Cove Beach		•									1

Number of locations	**17**	**12**	**6**	**6**	**5**	**5**	**3**	**3**	**1**	**1**	**59**
Total # of reports	**31**	**21**	**9**	**11**	**11**	**6**	**10**	**5**	**1**	**1**	**106**

The least commonly reported mammals were bobcat (1) and bear (1). As area sensitive carnivores that are not predominantly associated with water, the remaining wild areas in Burlington were perhaps less well suited to them. At the present time, it is unlikely that bobcat or bear are resident species in Burlington. It is likely that seven of the eight remaining target species have resident populations in Burlington. Moose are not residents, since they become stressed by summer temperature of over 56°, but the frequency of moose sightings appears to be on the rise.

Nearly 90% of all mammal reports were recorded in the last five years. The records included 13 data points that lie outside of the Burlington City limits, but within areas that are essentially contiguous with mapped mammal habitat—6 from Red Rocks Park and 7 from the South Burlington section of Centennial Woods. These data points were included to help document habitat connections in neighboring towns.

Tracking Effectiveness

In a single winter, strategic winter tracking efforts provided 35% of all records (37 of 106). Two years of quarterly outings on a single Keeping Track® transect in the Burlington Intervale and Ethan Allen Homestead provided 18% of all records (19 of 106). The two tracking approaches combined therefore provided more than half (53%) of all records of mammals in Burlington. In other words, concerted tracking efforts by about a dozen people (who with only one exception were Keeping Track® trained trackers) more than doubled the number of confirmed reports of large mammals in the Burlington area. This study shows that focused tracking efforts can significantly increase the documented presence of large mammals, even with small numbers of trained trackers in a single winter season. Therefore, the continued training of Keeping Track® trackers is clearly critical to ongoing efforts to document the presence of large mammals in the region.

Collaborative Efforts for Ongoing Success

This project has established important baseline data on the presence of large mammals and their use of habitat and corridors in Burlington. However, ongoing monitoring will enhance current understanding and may reveal further insights about mammal habitat and corridors. Ongoing efforts will be collaborative and involve Winooski Valley Park District, Keeping Track®, University of Vermont, town planners, and the Burlington Conservation Board. Several important next steps will ensure the ongoing success of the project by expanding upon existing data and ensuring its up-to-date availability:

- *Keeping Track® transect monitoring*

Continue to monitor the existing transect at the Ethan Allen Homestead and Burlington Intervale. Train more trackers through the Keeping Track® training program to monitor additional transects in Burlington and surrounding towns and to provide additional trackers for strategic winter tracking.

- *Strategic winter tracking.*

Continue strategic winter tracking in suspected corridors to support and strengthen existing data and focus additional efforts on core areas and the corridors between them that have not been sampled intensively. In addition to the suspected corridors on North Avenue, Grove Street and the lakeshore, future strategic winter tracking should include: the Howe Farm, Rock Point/Arms Grant/North Beach, the Country Club, Ethan Allen Park, and Englesby Ravine.

- *Eyewitness reports*

Disseminate eyewitness report forms and institute a system for verification of responses. Eyewitness reports from citizens, though not always reliable, constitute an enormous potential source of data on large mammals. By requiring citizens to answer questions about what they saw, how they made the determination that they did, and their level of ability, it is possible to verify eyewitness reports from citizens. (See sample Eyewitness Report Form – Appendix III). Explore the possibility of developing a website

where citizens could submit eyewitness reports and access up-to-date information about large mammal sign and sightings.

- *ArcView® GIS database of large mammals*

Establish a protocol for maintaining and updating the large mammal database. This includes identifying the best place to store information so that it will be accessible and deciding who will keep the records current.

Recommendations for City Actions

The following actions by the City of Burlington can increase protection for large mammals and their habitat:

1. *Ensure long term protection of core habitat.*

The best examples of core mammal habitat in Burlington include: the Winooski River Corridor (comprising the Intervale, Ethan Allen Homestead, Howe Farm, and Derway Island), the area west of North Avenue and north of the Urban Reserve (encompassing the Arms Grant, North Beach, and Rock Point), and Centennial Woods. Many of these lands already enjoy some degree of protection. The City should ensure that existing protection measures are adequate to protect large mammal habitat and that allowed human uses (e.g. recreational and agricultural) do not adversely affect wildlife. Core habitat areas that are not currently protected should be areas where the City focuses efforts to bring about protection.

2. *Make protection of habitat connectivity, including key wildlife corridors, a priority.*

Three suspected mammal corridors within Burlington have been identified in this study; they are along North Avenue, Grove Street, and the lakeshore. The City should make protection of these areas a priority by working with landowners or considering acquisition if that option becomes available. Several connections to open space and high quality mammal habitat in neighboring towns exist. The City should work with the Town of Colchester and Cities of South Burlington and the City of Winooski to ensure the long term protection of these connections.

3. *Work with people in neighborhoods of suspected wildlife corridors to maintain their land's permeability to wildlife.*

Several neighborhoods lie in the midst of suspected corridors. Examples of such neighborhoods include: North Avenue between the railroad underpass and Burlington High School; North Cove Road; parts of the lakeshore; and along Grove Street.

The City should consider educating landowners about their proximity to wildlife habitat and should encourage them to take simple actions to facilitate mammal movement without inviting unwanted encounters. Actions that discourage unwanted encounters include not leaving food or garbage outside and taking precautions to reduce pet/wildlife interactions. Wildlife movement can be encouraged by removing impenetrable fencing or replacing it with permeable fences like hedgerows.

4. *Restore existing publicly owned features to improve wildlife movement.*

The safe movement of wild mammals in the City can be enhanced through a couple of relatively simple actions. City-owned property with fencing that prohibits movement of animals could be raised 6 inches off the ground to make them barriers to people but not animals or replaced with natural fences such as hedgerows. Roadside signs in identified mammal habitat areas could be posted to minimize roadkill. Road construction or alteration projects can take mammal movement into consideration in their planning and design.

5. *Continue monitoring to confirm animal movement and to help assess the status of animal populations, both through Keeping Track® transect monitoring and strategic winter tracking.*

Focused tracking efforts by trained trackers can significantly increase documentation of large mammals in the region. Tracking data can assist city planning efforts by providing information that can allow planners to accommodate wildlife presence and minimize unwanted encounters. The City should support ongoing tracking efforts and additional tracker training through Keeping Track® both as an educational tool and as a means to further elucidate understanding of mammal habitat and corridors in the region.

6. *Consider adding a Large Mammal Habitat and Corridor Map into a future Burlington Open Space Planning document.*

A map that details the use of open space by large mammals would add important specific information to this planning document.

7. *Review and enforce violations of environmental regulations that adversely affect wildlife and their habitat within the City.*

Dogs off leashes are an example of a recreational use of certain natural areas the negatively impacts native wild animals. Where such areas are posted, enforcement of leash laws is critical.

8. *Consider posting animal crossing signs at the corridors across North Avenue.*

Fox and coyote tracks were observed crossing North Avenue over the railroad underpass and crossing North Avenue to go through the gap in the fences between Lakeview Cemetary and Burlington High School. If further tracking efforts revel that these suspected corridors are in frequent use, then signs that alert motorists of these crossings may be in order.

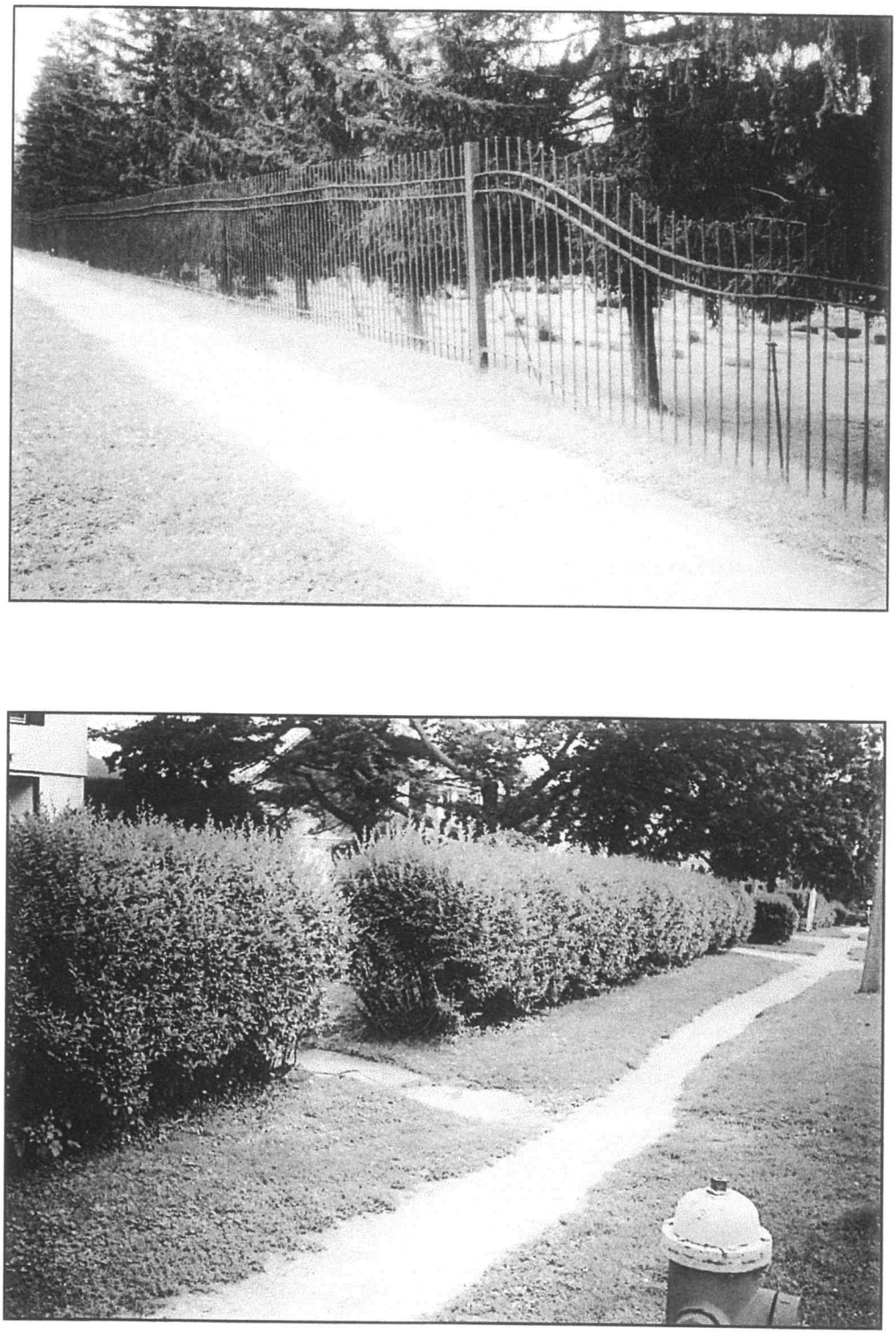


Figure 4. The top photo shows a fence in Burlington that is impenetrable to most large mammals. The hedgerow with gaps in it (bottom) is much more conducive to large animal travel. An alternative to replacing a fence with a hedgerow would be to raise the fence at least 6 inches off the ground.

Appendix I

Burlington Large Mammal Habitat & Corridor Project
Strategic Winter Tracking Protocol

Thanks for your assistance with the Burlington large mammal habitat & corridor project. The idea behind strategic winter tracking is to help document the use of corridors in Burlington. We have broken down the city into several zones and are counting on you to help. After a snowfall, visit the locations in your zone and document tracks and sign that you encounter. To maximize tracking effectiveness, wait a day or two after a fresh snowfall before visiting your locations, *unless* tracks or sign are likely to be readily obscured by wind, humans, or dogs (locations where this is the case should be visited as soon as possible). Record the information and send or deliver it to the Winooski Valley Park District office.

The following should help guide your information gathering:

Species to be monitored:

- Any Keeping Track® focal species (bear, moose, otter, mink, bobcat, fisher)
- beaver
- fox
- deer
- coyote

Information to record:

- Date of your outing.
- Describe tracking conditions (i.e. time since snowfall, other substrates, etc).
- Type of sign.
- Measurements of track size, stride length, or other information that helped you decide which species you observed.
- Briefly describe how you ruled out other similar species.
- Record the location of the sighting on a map or make a sketch of the landscape features that will help someone else mark the exact location on a map.
- Photographs (or slides) of sign are also very helpful especially if they include an identifiable Burlington feature.
- Take note of any obstructions to animal movement at any of the sites that you visit (for example: fences, blocked culverts, etc.).

Appendix II

Attribute Table for Large Mammals in Burlington

ID	species	date	Location	Precise?	Source	Observer	Sign	Photos
1	mink	June 17, 1999	Intervale	yes	Keeping Track transect		Tracks	yes
2	mink	Feb. 27, 2000	Intervale	yes	Keeping Track transect		Tracks	yes
3	fisher	June 17, 1999	Intervale	yes	Keeping Track transect		Tracks	yes
4	fisher	Feb. 27, 2000	Intervale	yes	Keeping Track transect		Tracks	yes
5	river otter	Feb. 27, 2000	Intervale	yes	Keeping Track transect		Tracks	yes
6	fisher	Feb. 22, 1999	Intervale	yes	Keeping Track transect		Tracks	yes
7	beaver	Feb. 22, 1999	Intervale	yes	Keeping Track transect		Chew	no
8	red fox	Feb. 22, 1999	Intervale	yes	Keeping Track transect		Tracks	no
9	mink	Feb. 22, 1999	Intervale	yes	Keeping Track transect	Monitoring team	Tracks	yes
10	fisher	Feb. 22, 1999	Intervale	yes	Keeping Track transect	Monitoring team	Tracks	yes
11	red fox	Feb. 22, 1999	Intervale	yes	Keeping Track transect	Monitoring team	Tracks	no
12	mink	Feb. 22, 1999	Intervale	yes	Keeping Track transect	Monitoring team	Tracks	yes
13	fisher	Feb. 22, 1999	Intervale	yes	Keeping Track transect	Monitoring team	Tracks	yes
14	red fox	Feb. 22, 1999	Intervale	yes	Keeping Track transect	Monitoring team	Tracks	no
15	coyote	Feb. 22, 1999	Intervale	yes	Keeping Track transect	Monitoring team	Tracks	no
16	fisher	Feb. 22, 1999	Intervale	yes	Keeping Track transect	Monitoring team	Tracks	yes
17	coyote	Feb. 22, 1999	Intervale	yes	Keeping Track transect	Monitoring team	Tracks	no
18	red fox	Feb. 22, 1999	Intervale	yes	Keeping Track transect	Monitoring team	Tracks	no
19	deer	1999-2000	Intervale	no	Keeping Track transect	Monitoring team	Tracks, sca	no
20	moose	Jan. 23, 2000	Manhattan Drive	no	Newspaper article		Sighting	yes
21	moose	Feb. 15, 2000	University Terrace	no	Newspaper article		Sighting	yes
22	moose	Jan. 23, 2000	Landfill Road	yes	Strategic winter tracking	Ben Gabos	Tracks	yes
23	red fox	Jan. 23, 2000	Centennial Brook	yes	Strategic winter tracking	Ben Gabos	Tracks	yes
24	mink	1999-2000	Winooski River	no	Eyewitness report	Jeff Meyers		no
25	river otter	1999-2000	Winooski River	no	Eyewitness report	Jeff Meyers		no
26	red fox	1999-2000	Winooski River	no	Eyewitness report	Jeff Meyers		no
27	coyote	1999-2000	Winooski River	no	Eyewitness report	Jeff Meyers		no
28	moose	1999-2000	Winooski River	no	Eyewitness report	Jeff Meyers		no
29	red fox	1999-2000	Derway/Northshor	no	Eyewitness report	Jeff Meyers		no
30	mink	1999-2000	Derway/Northshor	no	Eyewitness report	Jeff Meyers		no
31	river otter	1999-2000	Derway/Northshor	no	Eyewitness report	Jeff Meyers		no
32	red fox	Sept. 1996	Rock Point	yes	Eyewitness report	Alicia Daniel	Sighting	no
33	fisher	1996	Rock Point	yes	Eyewitness report	Alicia Daniel	Sighting	no
34	beaver	1998	North Beach	yes	Eyewitness report	Alicia Daniel	Sighting	no
35	moose	1998	Red Rocks	yes	Eyewitness report	Alicia Daniel	Sighting	no
36	deer	1995	Red Rocks	yes	Eyewitness report	Alicia Daniel	Sighting	no
37	grey fox	1995	Country Club	yes	Eyewitness report	Alicia Daniel	Sighting	no
38	red fox	1996	Barge Canal	yes	Eyewitness report	Alicia Daniel	Sighting	no
39	mink	1995-1999	Boathouse	yes	Eyewitness report	Kevin Rose	Sighting	no
40	red fox	1998	Arms Grant	yes	Eyewitness report	Alicia Daniel	Sighting	no
41	beaver	1996	Centennial Woods	yes	Eyewitness report	Alicia Daniel	Sighting	no
42	red fox	Jan. 21, 2000	Centennial Woods	yes	Strategic winter tracking	Mark Ward	Sighting	no
43	coyote	Feb. 6, 2000	North Ave./RR trac	yes	Strategic winter tracking	Ron Baker	Tracks	no
44	red fox	Feb. 6, 2000	Lakeview Cemetary	yes	Strategic winter tracking	Ron Baker	Tracks	no
45	red fox	March 4, 2000	Sea Caves Upland	yes	Strategic winter tracking	Ron Baker	Tracks	yes
46	red fox	Jan. 29, 2000	Red Rocks	yes	Strategic winter tracking	Jeff Severson	Tracks/uri	no
47	beaver	Feb. 27, 2000	Barge Canal	yes	Strategic winter tracking	Jeff Severson	Chew	no
48	mink	Feb. 27, 2000	Barge Canal	yes	Strategic winter tracking	Jeff Severson	Tracks	no
49	mink	March 18, 200	Blanchard Beacch	yes	Strategic winter tracking	Jeff Severson	Tracks	no
50	red fox	March 18, 200	Englesby Ravine	yes	Strategic winter tracking	Jeff Severson	Tracks/uri	no
51	mink	March 18, 200	South Cove Beach	yes	Strategic winter tracking	Jeff Severson	Tracks	no
52	mink	March 18, 200	Red Rocks	yes	Strategic winter tracking	Jeff Severson	Tracks	no

ID	species	date	Location	Precise?	Source	Observer	Sign	Photos
53	red fox	March 18, 200(	Red Rocks	yes	Strategic winter tracking	Jeff Severson	Tracks	no
54	mink	March 19, 200(	Centennial Brook	yes	Strategic winter tracking	Ben Gabos	Tracks	yes
55	red fox	March 19, 200(	Centennial Brook	yes	Strategic winter tracking	Ben Gabos	Tracks	yes
56	moose	March 16, 200(	Centennial Woods	yes	Strategic winter tracking	Ben Gabos	Tracks/ba	yes
57	red fox	Jan. 8, 2000	Valley Ridge	yes	Strategic winter tracking	Mark Ward	Tracks	no
58	deer	Jan. 8, 2000	Valley Ridge	yes	Strategic winter tracking	Mark Ward	Tracks	no
59	red fox	Jan. 28, 2000	Leddy Park	yes	Strategic winter tracking	Mark Ward	Tracks	no
60	deer	Jan. 29, 2000	Centennial Woods	yes	Strategic winter tracking	Mark Ward	Tracks	no
61	deer	Feb. 6, 2000	Centennial Woods	yes	Strategic winter tracking	Mark Ward	Tracks/sca	no
62	red fox	Feb. 7, 2000	Leddy Park	yes	Strategic winter tracking	Mark Ward	Tracks/uri	no
63	red fox	Feb. 12, 2000	Derway/Northshor(	yes	Strategic winter tracking	Mark Ward	Tracks/de	no
64	red fox	Feb. 12, 2000	Leddy Park	yes	Strategic winter tracking	Mark Ward	Tracks	no
65	mink	March 4, 2000	Centennial Brook	yes	Strategic winter tracking	Mark Ward	Tracks	no
66	mink	March 4, 2000	Valley Ridge	yes	Strategic winter tracking	Mark Ward	Tracks	no
67	red fox	March 4, 2000	Valley Ridge	yes	Strategic winter tracking	Mark Ward	Tracks	no
68	mink	March 4, 2000	Centennial Woods	yes	Strategic winter tracking	Mark Ward	Tracks	no
69	mink	March 4, 2000	Centennial Woods	yes	Strategic winter tracking	Mark Ward	Tracks/sca	no
70	moose	March 4, 2000	Centennial Woods	yes	Strategic winter tracking	Mark Ward	Tracks/sca	no
71	deer	March 4, 2000	Centennial Woods	yes	Strategic winter tracking	Mark Ward	Scat	no
72	moose	March 9, 2000	Derway Island	yes	Strategic winter tracking	Mark Ward	Scat	no
73	deer	March 9, 2000	Derway Island	yes	Strategic winter tracking	Mark Ward	Tracks	no
74	mink	March 9, 2000	Derway Island	yes	Strategic winter tracking	Mark Ward	Sighting	no
75	beaver	March 9, 2000	Winooski River	yes	Strategic winter tracking	Mark Ward	Tracks	no
76	red fox	March 18, 200(	North Ave/RR track	yes	Eyewitness report	Susan Young	Tracks	no
77	moose	March 18, 200(	Centennial Woods	yes	Eyewitness report	Susan Young	Sighting	no
78	mink	March 11, 200(	Intervale	yes	Eyewitness report	Kimberly Rockwo(	Sighting	no
79	mink	May 17, 2000	Ethan Allen Homes	yes	Eyewitness report	Brian Claussen	Sighting	no
80	deer	May 30, 2000	Intervale	yes	Eyewitness report			no
81	deer	1997	Centennial Woods	no	Field Naturalist project			no
82	fisher	1997	Centennial Woods	no	Field Naturalist project			no
83	red fox	1997	Centennial Woods	no	Field Naturalist project			no
84	beaver	1997	Centennial Woods	no	Field Naturalist project			no
85	red fox	pre-1995	Arms Grant Woods	no	Field Naturalist project			no
86	deer	pre-1995	Arms Grant Woods	no	Field Naturalist project			no
87	beaver	pre-1995	Northshore wetlanc	no	Field Naturalist project			no
88	red fox	pre-1995	Northshore wetlanc	no	Field Naturalist project			no
89	mink	pre-1995	Northshore wetlanc	no	Field Naturalist project			no
90	river otter	pre-1995	Northshore wetlanc	no	Field Naturalist project			no
91	beaver	pre-1995	Intervale	no	Field Naturalist project			no
92	black bear	pre-1995	Intervale	no	Field Naturalist project			no
93	coyote	pre-1995	Intervale	no	Field Naturalist project			no
94	mink	pre-1995	Intervale	no	Field Naturalist project			no
95	moose	pre-1995	Intervale	no	Field Naturalist project			no
96	red fox	pre-1995	Intervale	no	Field Naturalist project			no
97	river otter	pre-1995	Intervale	no	Field Naturalist project			no
98	fisher	April 20, 2000	Centennial Woods/	yes	Eyewitness report	Susan Alden	Tracks	no
99	red fox	Feb. 2000	Ethan Allen Homes	yes	Eyewitness report	Seth Coffee	Sighting	no
100	bobcat	1999	Intervale	yes	Eyewitness report	Jennifer Ely	Tracks	no
101	red fox	1999	Intervale	yes	Eyewitness report	Mark Ward	Sighting	no
102	beaver	1998	Winooski River	yes	Eyewitness report	Mark Ward	Sighting	no
103	moose	1999	Red Rocks	yes	Eyewitness report	Alicia Daniel	Tracks	no
104	river otter	1999	Centennial Woods/	yes	Eyewitness report	Susan Alden	Tracks	no
105	fisher	March 28, 200(	Centennial Woods/	yes	Eyewitness report	Kim Norris	Sighting	no
106	deer	1999	Centennial Woods/	yes	Eyewitness report	Susan Alden	Sighting	no

Appendix III

Eyewitness Report Form

Large Mammal Habitat & Corridors Project

Eyewitness Report

Please fill out this report as completely as you can.

Species Name _____

Date of Sighting _____

Sighting Location Information
Town _____
Name of specific location (if applicable)_____
Directions to the location (include a map if possible)

_____
_____
_____
_____

Did you observe the animal directly or was the presence of the animal deduced indirectly (e.g. through tracks, scat, etc.)?

_____

What field characteristics did you use to identify this species? (Be as specific as possible. If applicable, include tracking conditions, measurements of track size, etc.)

_____
_____
_____
_____

What information did you use to rule out other similar species? (Please answer carefully.)

_____
_____
_____
_____

How familiar are you with the field identification of this species? Have you identified it before? How many times?

_____
_____

High quality photographs allow others to verify your report. If possible, please include labeled photos as evidence.

Observers' names, addresses, and phone numbers:

_____

Please send completed reports to: **Winooski Valley Park District, Ethan Allen Homestead, Burlington, VT 05401**

Appendix IV

Figure 2. Adapted to Black and White

Figure 2. Large mammal habitat in Burlington, VT and the locations of mammal track, sign and sightings June 2000.